

CLAIMS:

1. An improved machine vision vehicle wheel alignment system having at least one camera, a computer operatively coupled to the at least one camera, the computer configured with vehicle wheel alignment software, and at least one optical target configured for attachment to a vehicle within a field of view of the at least one camera, wherein the improvement comprises:

at least one additional camera mounted to a vehicle service apparatus, said at least one additional camera operatively coupled to the computer, said at least one additional camera disposed to include at least one optical target in an associated field of view; and

wherein said computer is further configured to utilize images of the at least one optical target received from said at least one additional camera to guide the placement of the vehicle service apparatus relative to the vehicle.

2. The improved machine vision vehicle wheel alignment system of Claim 1 wherein said computer is further configured to guide the placement of the vehicle service apparatus relative to a rear thrust line of said associated vehicle.

3. The improved machine vision vehicle wheel alignment system of Claim 1 wherein said vehicle service apparatus is a vehicle collision avoidance system alignment fixture.

4. An improved machine vision vehicle wheel alignment system having at least one camera, a computer operatively coupled to the at least one camera, the computer configured with vehicle wheel alignment software, and at least one optical

target configured for attachment to a vehicle within a field of view of the at least one camera, wherein the improvement comprises:

at least one additional optical target configured for attachment to a vehicle service apparatus within a field of view of the at least one camera; and

wherein said computer is further configured to utilize images of the at least one additional optical target received from the at least one camera to guide the placement of the vehicle service apparatus relative to the associated vehicle.

5. The improved machine vision vehicle wheel alignment system of Claim 4 wherein said computer is further configured to guide the placement of the vehicle service apparatus relative to a rear thrust line of said associated vehicle.

6. The improved machine vision vehicle wheel alignment system of Claim 4 wherein said vehicle service apparatus is a collision avoidance system alignment fixture.

7. The improved machine vision vehicle wheel alignment system of Claim 4 wherein a field of view of the at least one camera is adjustable to selectively view the at least one optical target configured for attachment to a vehicle and to selectively view said at least one additional optical target configured for attachment to a vehicle service apparatus.

8. A method for aligning a vehicle service apparatus relative to an associated vehicle utilizing a machine vision vehicle wheel alignment system having at least one camera, a computer operatively coupled to the at least one camera, the computer configured with vehicle wheel alignment software, and at least one optical

target configured for attachment to a vehicle within a field of view of the at least one camera, comprising the steps of:

mounting the at least one optical target on the associated vehicle in the field of view of the at least one camera;

acquiring, at the computer, data representative of the position and orientation of one or more components of the associated vehicle from one or more images of the at least one optical target acquired by the at least one camera;

mounting at least one additional camera on the vehicle service apparatus, said at least one additional camera operatively coupled to the computer and having a field of view including the at least one optical target;

acquiring, at the computer, data representative of the position and orientation of the vehicle service apparatus from one or more images of the at least one optical target acquired by said at least one additional camera; and

guiding the placement of the vehicle service apparatus relative to the associated vehicle utilizing said acquired position and orientation of the one or more components of the associated vehicle and said acquired position and orientation of the vehicle service apparatus.

9. The method for aligning a vehicle service apparatus of Claim 8 further including the step of determining the rear thrust line of the associated vehicle from said acquired data representative of the position and orientation of one or more components of the associated vehicle; and

wherein the step of guiding further includes guiding the placement of the vehicle service apparatus relative to said rear thrust line of the associated vehicle.

10. A method for aligning a vehicle service apparatus relative to an associated vehicle utilizing a machine vision vehicle wheel alignment system having at least one camera, a computer operatively coupled to the at least one camera, the computer configured with vehicle wheel alignment software, and at least one optical target configured for attachment to a vehicle within a field of view of the at least one camera, comprising the steps of:

mounting the at least one optical target on the associated vehicle in the field of view of the at least one camera;

acquiring, at the computer, data representative of the position and orientation of one or more components of the vehicle from one or more images of the at least one optical target acquired by the at least one camera;

mounting one or more additional optical targets on the vehicle service apparatus, said one or more additional optical targets in a field of view of the at least one camera;

acquiring, at the computer, data representative of the position and orientation of the vehicle service apparatus from one or more images of the at least one additional optical targets acquired by the at least one camera; and

guiding the placement of the vehicle service apparatus relative to the associated vehicle utilizing said acquired position and orientation of the one or more components of the associated vehicle and said acquired position and orientation of the vehicle service apparatus.

11. The method for aligning a vehicle service apparatus of Claim 10 further including the step of determining the rear thrust line of the associated vehicle from the

acquired data representative of the position and orientation of one or more components of the associated vehicle; and

wherein the step of guiding further includes guiding the placement of the vehicle service apparatus relative to said rear thrust line of the associated vehicle.

12. A method for aligning a vehicle service apparatus relative to an associated vehicle, the vehicle service apparatus having a steer axis and a pair of lateral extension arms disposed perpendicular to the steer axis, a camera disposed on each of the lateral extension arms, comprising the steps of:

mounting a first optical target on a first side of the associated vehicle in a field of view of a first of the cameras;

mounting a second optical target on a second side of the associated vehicle in a field of view of a second of the cameras;

acquiring one or more images of said first optical target with the first camera;

acquiring one or more images of said second optical target with the second camera;

identifying at least one vehicle measurement from each of said images acquired with the first and second cameras;

comparing said at least one vehicle measurement from said image acquired with the first camera with said at least one vehicle measurement from said image acquired with the second camera; and

guiding the placement of the vehicle service apparatus relative to the associated vehicle utilizing said compared measurements.

13. The method of Claim 12 for aligning a vehicle service apparatus relative to an associated vehicle wherein said first and second optical targets are mounted on opposite rear wheels of the vehicle, respectively.

14. The method of Claim 12 for aligning a vehicle service apparatus relative to an associated vehicle wherein the step of identifying a plurality of vehicle measurements includes identifying a left wheel rotation axis and a right wheel rotation axis.

15. The method of Claim 14 for aligning a vehicle service apparatus relative to an associated vehicle wherein said left rear wheel rotation axis is identified in a first camera coordinate system, and wherein said right rear wheel rotation axis is identified in a second camera coordinate system.

16. The method of Claim 14 for aligning a vehicle service apparatus relative to an associated vehicle further including the steps of

identifying, for each camera, a mounting shaft axis; and

comparing said first camera mounting shaft axis with said left rear wheel rotation axis to identify a first comparison angle; and

comparing said second camera mounting shaft axis with said right rear wheel rotation axis to identify a second comparison angle.

17. The method of Claim 16 for aligning a vehicle service apparatus relative to an associated vehicle wherein

said step of comparing measurements further includes comparing said first comparison angle with said second comparison angle; and

wherein said step of guiding the placement of the vehicle service apparatus relative to the associated vehicle includes directing an operator to alter the placement of the vehicle service apparatus until said first comparison angle equals said second comparison angle to within a predetermined tolerance.

18. An improved vehicle service apparatus having a housing configured for placement relative to an associated vehicle, the improvement comprising:

a first camera coupled to the housing and having a first field of view including a first side of the associated vehicle;

a second camera coupled to the housing and having a second field of view including a second side of the associated vehicle, said second side opposite said first side;

a first optical target configured for attachment to the associated vehicle in said first field of view;

a second optical target configured for attachment to the associated vehicle in said second field of view; and

a computer configured to receive data from said first and second cameras and to guide the placement of the housing relative to the associated vehicle utilizing said received data.

19. The improved vehicle service apparatus of Claim 18 wherein the housing has a steer axis, and the associated vehicle has a thrust line; and

wherein said computer is configured to guide the placement of the housing such that said steer axis of the housing is aligned parallel to said thrust line of the associated vehicle.

20. The improved vehicle service apparatus of Claim 18 further including:
a left lateral extension arm fixedly secured to said housing;
a right lateral extension arm fixedly secured to said housing opposite said left lateral extension arm;
wherein said first camera is coupled to said left lateral extension arm; and
wherein said right camera is coupled to said right lateral extension arm.

21. A method for guiding placement of a vehicle service apparatus relative to an associated vehicle, comprising the steps of:

positioning a first camera and a first optical target to operatively determine a relationship between a component on a first side of the vehicle and the vehicle service apparatus;

positioning a second camera and a second optical target to operatively determine a relationship between a component on a second side of the vehicle and the vehicle service apparatus, said second side on an opposite side of the vehicle from said first side;

acquiring one or more images of said first optical target with the first camera;

acquiring one or more images of said second optical target with the second camera;

identifying at least one vehicle measurement from each of said images acquired with the first and second cameras;

comparing said at least one vehicle measurement from said image acquired with the first camera with said at least one vehicle measurement from said image acquired with the second camera; and

guiding the placement of the vehicle service apparatus relative to the associated vehicle utilizing said compared measurements.

22. The method of Claim 21 for guiding the placement of a vehicle service apparatus relative to an associated vehicle wherein said at least one vehicle measurement in each of said images acquired with the first and second cameras is identified relative to the vehicle service apparatus.

23. The method of Claim 21 for guiding the placement of a vehicle service apparatus relative to an associated vehicle further including the step of calibrating for misalignment between a mounting shaft axis of said first camera and a mounting shaft axis of said second camera.